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Mitigation Enabling Energy Transition in the MEDiterranean region

DAYLIGHT DESIGN – EDE3

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Training on GRASSMED – meetMED II

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OUTLINE

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- ✓ Why use DAYLIGHTING ?
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- ✓ Shading Devices
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  - Fixed and Movable
  - Manual and Automatic
- ✓ How to comply with GRASSMED?

What Is DAYLIGHTING?

- Providing Daylight is letting Natural Lighting penetrate to the occupied spaces through side lighting (windows) and/or top lighting (skylights, clerestory windows…).

- Daylighting is the practice of placing windows, skylights, other openings, and reflective surfaces so that sunlight (direct or indirect) can provide effective internal lighting.

Why Use DAYLIGHTING?

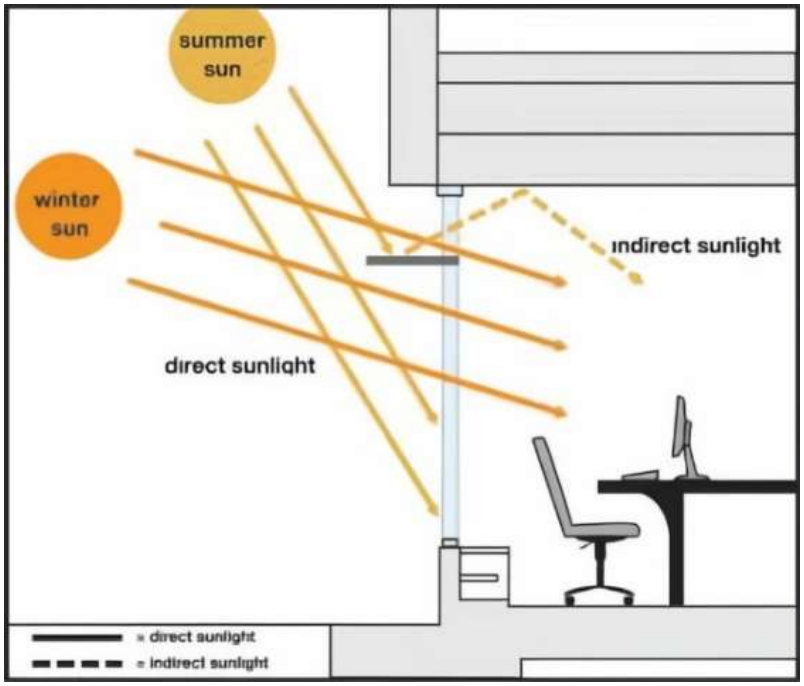
The two primary reasons for using daylight to meet the illumination requirements of an architectural space are the **energy savings benefits** and the **psychological benefits.**

1-Daylighting can **reduce energy consumption** by reducing the **use of electric artificial lighting.** When used **in conjunction with LED** lighting and controls (see module EDE 5A), it can **reduce the overall energy costs** of operating buildings during the day.

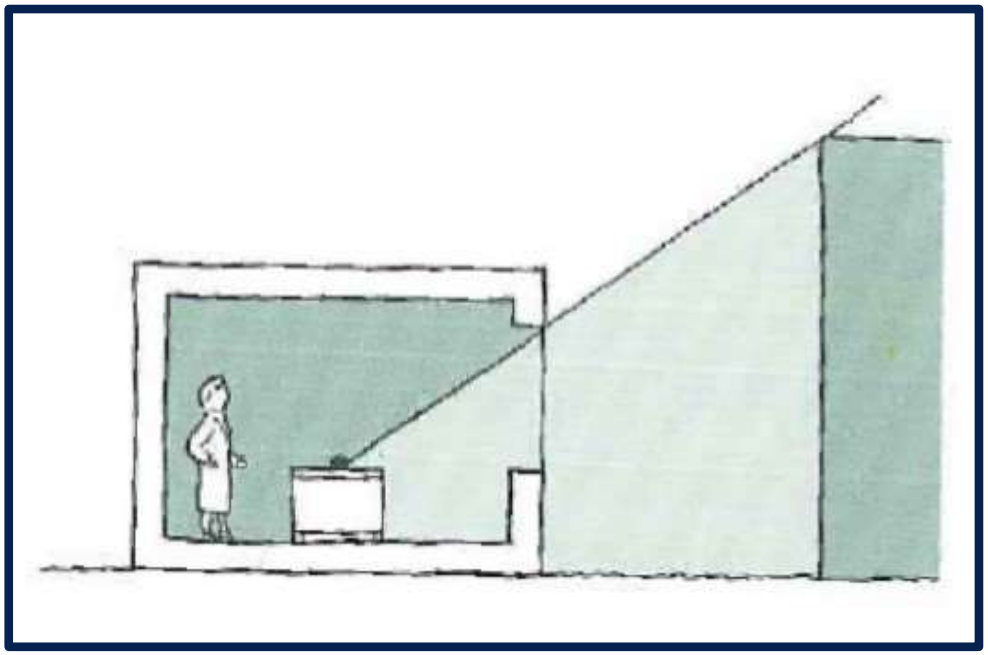
2-Good daylighting has been shown to increase the occupants' **productivity**, **comfort** and **well-being** by bringing the authentic presence of nature into their space (**Biophilic Design**).

How Can DAYLIGHTING Be Integrated?

- **Daylighting can be integrated directly and indirectly.**



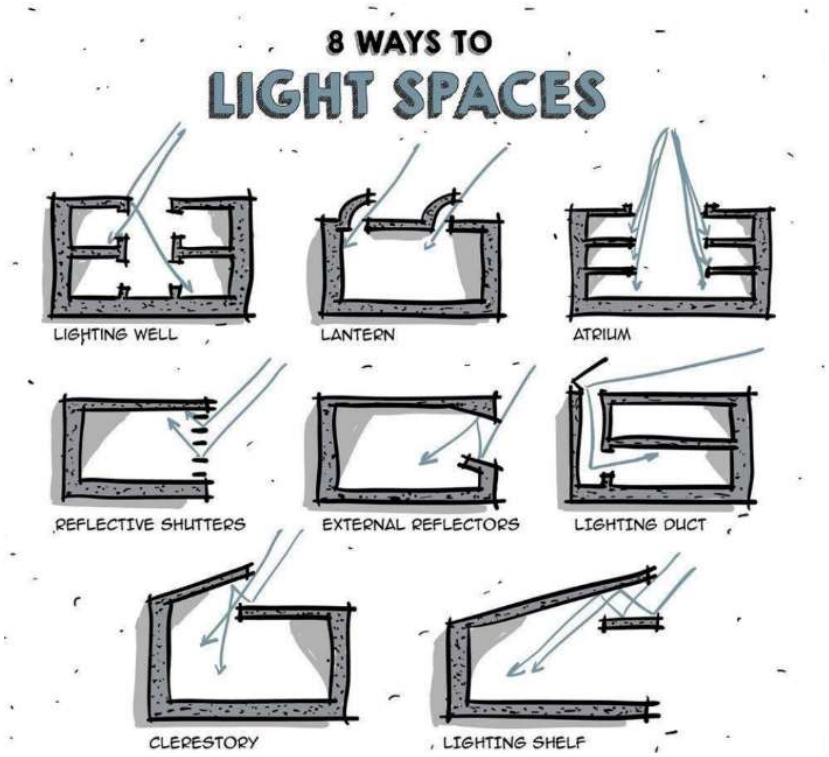
Sunlight diffused through openings is considered direct and reflected by surfaces and/or walls is considered indirect

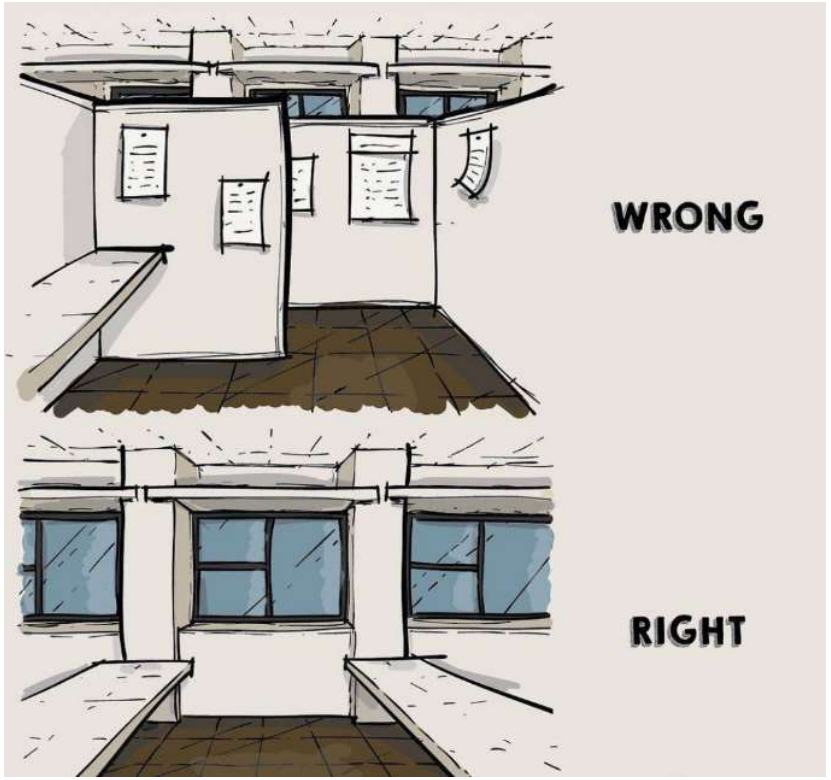


Since sunlight reflected off walls and the ground also contribute to daylight, then obstructions affect daylight distribution

How Can DAYLIGHTING Be Integrated?

There are many ways to overcome obstructions and borrow light within the indoor space.
Here below some examples to light spaces:



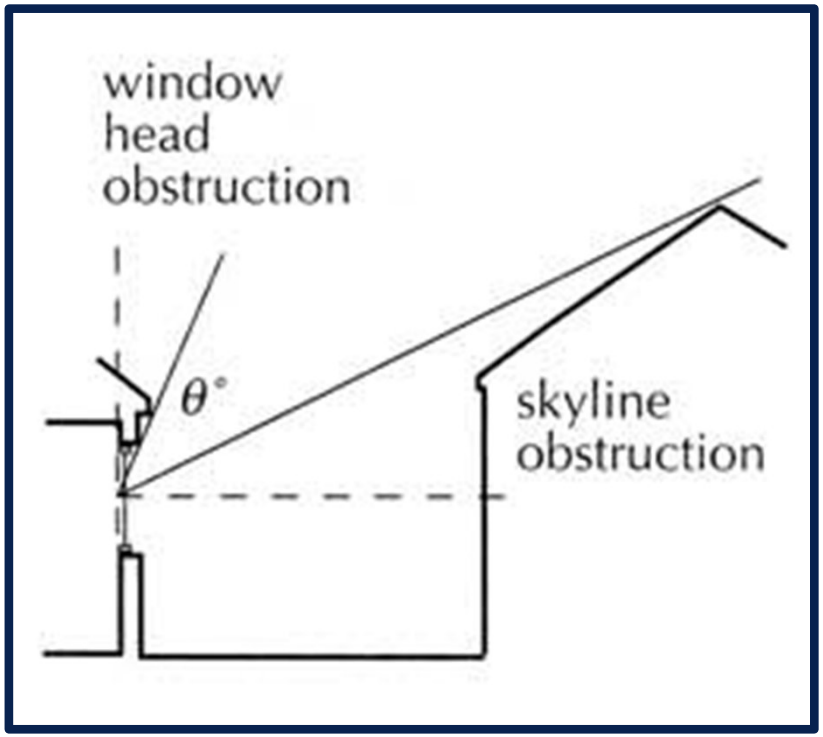


How To Calculate the Amount of Daylight?

The amount of daylight received in an internal space can be analyzed calculating an **Average daylight factor (ADF).** It is ratio of the interior illumination level within a room provided by daylight to the level of daylight outside the room :

$$ADF(\%) = \frac{V_t \times A_{Glazing} \times \theta}{A_S \times (1 - R^2)}$$

NB: ADF≥ 2% (efficient)



Where:

- **Vt is the transmittance of glass** including dirt effects ; It is a measure of the fraction of visible light that passes through a glazing (dimensionless);
- **A glazing is the net glazing area** in square-meter;
- **θ** is the **sky exposure angle**, in degrees, the angle of the sky visible from the center of the window (see the figure);
- As is the **area of all room surfaces** (ceiling, floor, walls and windows) in square –meter;
- **R** is the room surfaces **average reflectance** (dimensionless).

How To Calculate the Amount of Daylight?

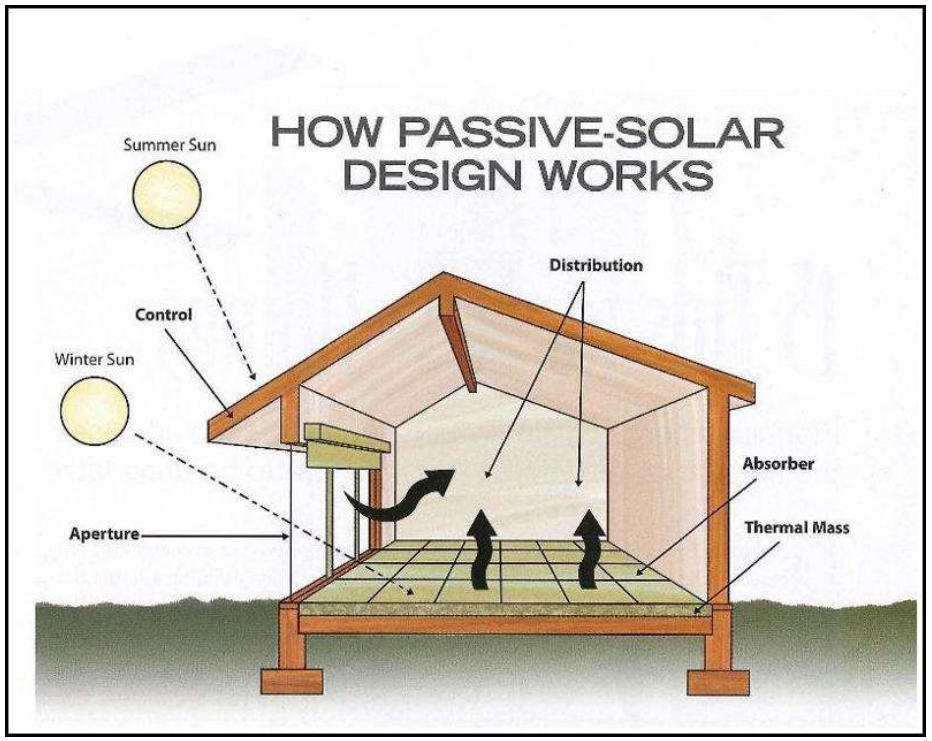
After calculating the **ADF** for each occupied space in the building, the **Compliance Factor (CF)** can be determined as the following:

$$CF = \frac{Total\ Floor\ Area\ of\ spaces\ having\ ADF \geq 2\%}{Total\ Floor\ Area\ of\ occupied\ spaces} \times 100$$

Un-occupied spaces containing mechanical equipment, copying machines, laundry, and rest rooms are not included within calculation.

Daylight and Thermal Performance

The sun is a **powerful light source** but it is also **a source of heat gain**.



- In **COLD Climates** in winter time, the Design Goal should be to get the **most of passive heating.**
- In **WARM Climates**, the Design Goal should be to meet **minimum illumination levels** without exceeding the solar heat gains in temperature.

Therefore, finding the **correct balance** between the **glass** (abundant natural lighting) and the **opaque surfaces** in the external façades helps **to maximize daylight** while **minimizing unwanted heat transfer** (see module E1-3).

Sample of Designing a Space with Natural Daylighting

- High Ceilings and windows with light shelves.
- Windows on adjacent and/or opposite walls.
- Light colored walls and ceilings.
- Combination of different glazing for the walls, skylights and/or clerestories.

Shading Devices

Shading devices are **important design elements of glazed facades** to **reduce energy consumption of buildings and improve thermal and visual comfort of occupants.**

The aim of good shading design is to utilize their characteristics to best advantage. Correctly designed, these sun controls are the most effective of all for **reducing solar radiation in warmer climates** since the absorbed heat is dissipated externally, in addition to **balancing solar gains and useful daylight based on the season.**

The different types of shading devices are:

- Exterior and Interior
- Fixed and Movable
- Manual and Automatic

Types of Shading Devices

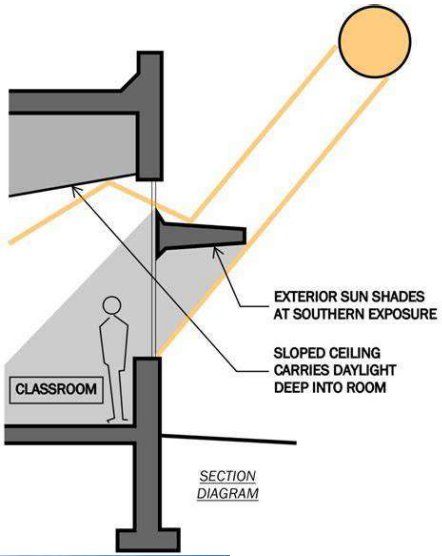
Exterior Shadings

Exterior shadings can be Vertical, Horizontal or Combined

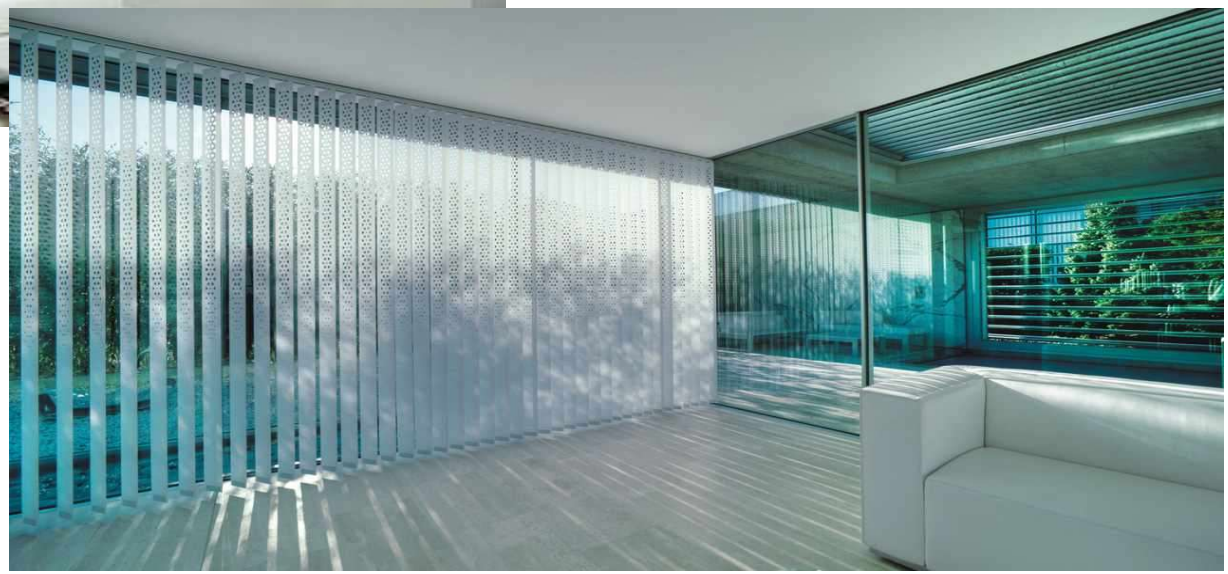
Vertical: useful during low incidence angle of sun rays

Horizontal: useful during high incidence angle of sun rays

Combined



Types of Shading Devices
Interior shadings

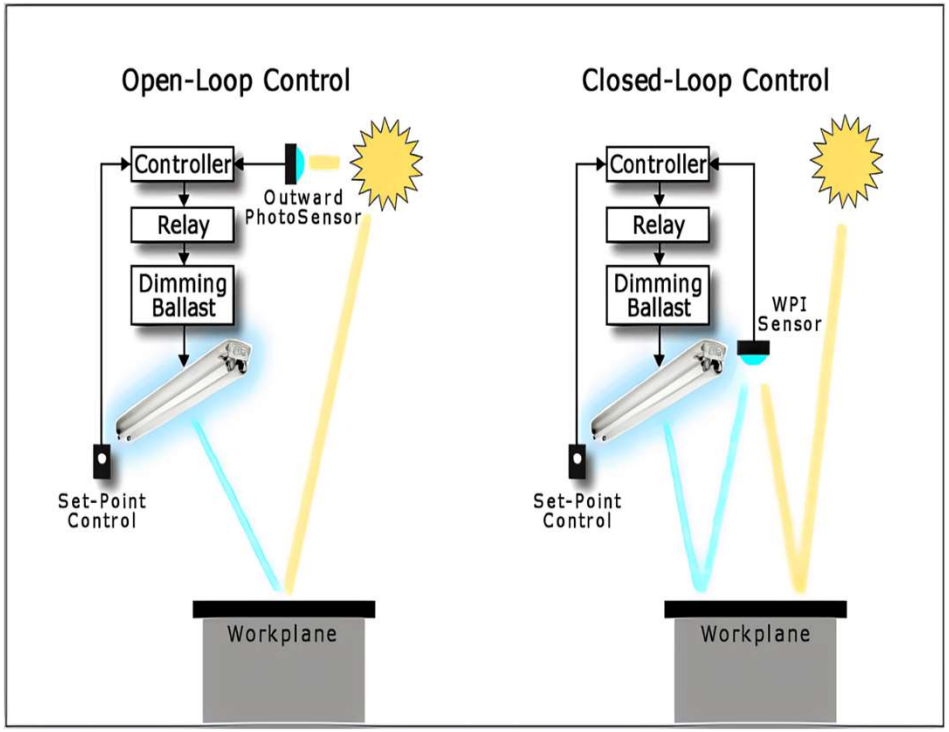


Types of Shading Devices
Fixed and Movable

Movable can be exterior and interior

Types of Shading Devices
Manual and Automatic

- Mobile shading devices allow, **manually or by automated systems**, control of sunlight based on **adaptation of solar radiation, indoor temperature, or illuminance level**
- **Photo sensors**, in the ceiling, are used to **measure the quantity of daylight in the space** then determine the amount of dimming required **to maintain the design work plane illuminance level**.



How To Comply With GRASSMED?

The maximum scoring points for Daylight Design - EDE 3, the **compliance factor** and the requirements for both **commercial and residential buildings** are given in the table below:

Maximum Scoring for Residential Buildings	**20**
Maximum Scoring for Commercial Buildings	**20**
Compliance Factor CF	Scoring Points
70% ≤ CF ≤ 80%	6
80.1% ≤ CF ≤ 90%	8
CF ≥ 90.1%	10
Requirements	Scoring Points
Install Manual Internal Shading	1
Install Automatic Internal Shading	2
Distribute Lighting Fixtures properly	3
Install Lighting Control Strategy	4

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For any inquires or comments,
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